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REVIEW ARTICLE

Major clinical considerations of the use of hydrophobic intraocular lenses in patients with cataracts: a brief systematic review

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Abstract

Introduction: Every year about 1 to 2 million people become blind and the number of blind people is predicted to reach 90 million in 2020. A cataract is the biggest cause of blindness in the world, except in developed countries. It accounts for 47.8% of the world's cases of blindness. A cataract is a name given to any opacity of the lens, which does not necessarily affect vision, with phacoemulsification being the main choice of treatment, which consists of a posterior aspiration of the emulsified material. **Objective:** The objective of this study was to evaluate, through a systematic review, the visual acuity, with less recourse to correction, in patients undergoing phacoemulsification with bilateral implants of hydrophobic lenses. **Methods:** The systematic review rules of the PRISMA Platform were followed. The literature search was carried out from July to August 2022 in Scopus, PubMed, Science Direct, Scielo, and Google Scholar databases. Scientific articles from the last 3 years were selected. The quality of the studies was based on the GRADE instrument. The risk of bias was analyzed according to the Cochrane instrument. **Results and Conclusion:** A total of 23 articles were included in this study, with 6 articles being from the main current clinical studies on the use of intraocular lenses. Both PCO value and Nd: YAG capsulotomy rates were higher in the hydrophobic acrylic IOL group than in the long-term use silicone (intraocular lens) IOL group (more than 6 years) after implantation. This study indicates excellent postoperative visual acuity and refractive results in the eyes following implantation of the EyeCee® One. This is accompanied by a very little risk of intraoperative and postoperative complications. Furthermore, the Aktis SP IOL is a safe, effective, and stable lens that can be inserted through a 2.2 mm incision with satisfactory visual and refractive results, even in the late postoperative period. Therefore, by analyzing the histopathological composition of PCO using LECs, more information can be gained about the characteristics of IOLs that are important for biocompatibility. Finally, patients implanted with trifocal IOLs showed a significant improvement in visual acuity at different distances, providing broad absolute and relative depth of field values, with good patient satisfaction rates.

Keywords: Cataract. Intraocular lenses. Hydrophobic lenses. Phacoemulsification. Opacification.

Introduction

Current data indicate that there are 50 million blind people in the world, about 180 million people with some visual impairment and 135 million with visual impairment and risk of blindness [1]. Each year around 1 to 2 million people become blind and the number of blind people is predicted to reach 90 million by 2020 [2]. Cataracts are the leading cause of blindness worldwide, except in developed countries. It accounts for 47.8% of the world's cases of blindness [3].

A cataract is anatomically defined as any opacification of the lens that diffracts light, harming vision. Changes can lead from minor visual distortions to blindness [1,48]. It can be of senile, congenital, traumatic, or secondary etiology. The main form of cataract is senile, on which epidemiological and prevalence studies should focus. Senile cataract is not considered a disease, but a normal aging process, with a higher incidence in the population over 50 years old [1].

The gradual increase in life expectancy has resulted in a consequent increase in the prevalence of this disease in recent decades. Thus, its prevalence is estimated at 2.5% between 40 and 49 years, 6.8% between 50 and 59 years, 20% between 60 and 69 years, 42.8% between 70 and 79 years, and 68.3% over 80 years [4]. Also, according to the WHO, the annual incidence of cataracts is estimated at 0.3% per year. This would represent, in Brazil, about 550,000 new cases of cataracts per year. It is considered a public health problem due to a large number of people with the disease, which increases every year [9].

Thus, cataract is the name given to any opacity of the lens, which does not necessarily affect vision, being considered the major cause of treatable blindness in developing countries [1,10]. This term arises from the occurrence of alterations in the lamellar architecture of this structure, with a worldwide consensus that the surgical approach is the only treatment for this disease [9].

Surgical techniques for cataract removal have shown a clear advance, demonstrating success in procedures and reductions in complications [11-14]. Among the most used techniques are extracapsular facetectomy (ECF) and phacoemulsification (FACO). Phacoemulsification is the main choice of treatment, which consists of a posterior aspiration of the emulsified material, through an incision of 3 mm or less, from the fragmentation of the lens [15-17].

The advantages of phacoemulsification over other surgical techniques come from the possibility of making smaller incisions that allow the surgeon to have better stability of intraocular structures during the surgical procedure and less tissue damage. Thus, with the advent of this surgical technique and the implantation of foldable intraocular lenses (IOL), a new stage was introduced in ophthalmology [13-17].

Foldable intraocular lenses, implanted through a small incision, have rapidly become widespread, due to rapid functional restoration and lower incidence of problems [11,12]. Thus, being included in this group, the most used hydrophobic acrylic lenses are the one-piece ones. The implantation of this lens must be done exclusively inside the capsular bag, and its handle has straight and thick edges. It can be said that one of the advantages of choosing this type of lens is that no cases of calcification have yet been found, which can be considered a post-surgical complication. Visual acuity may be increased in patients where hydrophobic lenses were implanted, with fewer correction resources [13,14].

Therefore, the present study aimed to evaluate the visual acuity, with less recourse to correction of patients, submitted to phacoemulsification with bilateral implants of hydrophobic lenses, as well as to analyze the visual acuity, for distance and near, in an uncorrected and corrected way, and to evaluate contrast sensitivity submitted to phacoemulsification with bilateral implants.

Methods

Study Design

The rules of a systematic review of the PRISMA Platform (Transparent reporting of systematic review and meta-analysis-HTTP://www.prisma-statement.org/) were followed.

Data Sources And Research Strategy

The search strategies for this systematic review were based on the keywords (MeSH Terms): "*Cataract. Intraocular lenses. Hydrophobic lenses. Phacoemulsification. Opacification*". The search literature was carried out from May to June 2022 in Scopus, PubMed, Science Direct, Scielo, and Google Scholar databases. Scientific articles from the last 3 years were selected. In addition, a combination of keywords with the Booleans "OR", "AND" and the "NOT" operator were used to target scientific articles of interest.

Study Quality And Risk Of Bias

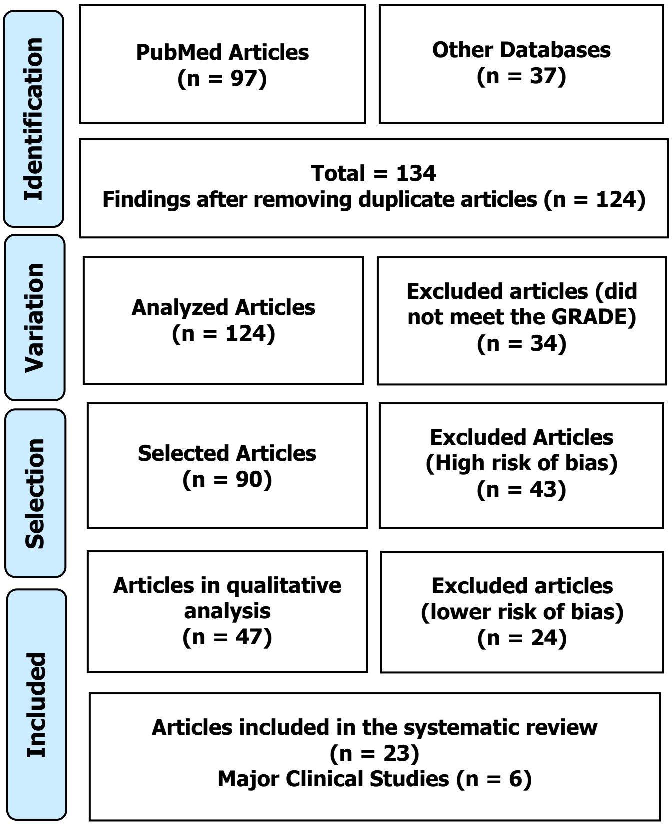
The quality of the studies was based on the GRADE instrument. The highest ratings were for controlled clinical studies with a sample size with statistical significance. The risk of bias was analyzed using the Cochrane instrument, based on the effect size of each study versus the sample size.

Results and Discussion

Major Findings

A total of 134 articles were found. Initially, article duplication was excluded. After this process, the abstracts were evaluated and a new exclusion was performed, removing articles that did not include the topic of this article, resulting in 47 articles. A total of 23 articles were included in this study, of which 6 articles were from the main current clinical studies on the use of intraocular lenses (**Figure 1**). Considering the Cochrane tool for risk of bias, the overall assessment resulted in 43 studies with a high risk of bias and 34 studies that did not meet the GRADE that was removed.

Figure 1. Flowchart showing the article selection process.



Major Clinical Findings

The hydrophobic acrylic intraocular lens (IOL) is the most popular material in cataract surgery. Posterior capsule opacification (PCO) is a long-term complication of cataract surgery. A meta-analysis study provided an assessment of 17 updated clinical studies of long-term complications and visual function after implantation of hydrophobic acrylic and silicone intraocular lenses from January 2000 to March 2021. The results of the analysis revealed a greater PCO value (Group 3: standardized mean difference: -0.59; CI: -0.90 to -0.28) and Nd: YAG capsulotomy rate (Group 3: hazard ratio (RR), 0.60; 95% CI, 0.40-0.89) for hydrophobic acrylic IOLs than silicone IOLs during long-term follow-up (≥6 years) [18].

In addition, a retrospective study evaluated the types and causes of IOL turbidity. Patients undergoing uncomplicated phacoemulsification and IOL implantation for cataracts were included. A total of 42,545 IOLs were implanted in the five years, of which 25,471 (66.0%) were hydrophilic IOLs, 11,881 (27.9%) were hydrophobic IOLs and 2,601 (6.1%) were hydrophilic-hydrophobic acrylic IOLs. Among the operated eyes, 14 eyes (13 patients) had IOL opacification, which was permanent for 10 IOLs, including 7 (0.6%) hydrophilic IOLs (860UV) and 3 (0.2%) hydrophilic-hydrophobic acrylic IOLs (L-312). The mean interval between surgery and the diagnosis of permanent opacification was 34.4 ± 18.4 months. Permanent clouding of the IOL caused a statistically significant reduction in best-corrected visual acuity. The IOL opacification rate was 0.03% [19].

Also, an observational study of 152 human eyes in the UK evaluated the visual, refractive, and safety outcomes in eyes after undergoing phacoemulsification and implantation of a pre-loaded monofocal hydrophobic acrylic intraocular lens. Preoperative, surgery-related, and 2 weeks and 3 months postoperative data were collected. Ninety-four (62%) of the eyes had cataracts, but no concomitant ocular pathology that could affect visual acuity. Three months postoperatively, 98.7% of all eyes had monocular corrected distance visual acuity (CDVA) ≤0.3 logMAR. 100% of eyes without concomitant ocular pathology achieved this goal. The mean CDVA of all eyes in this study improved from 0.43 ± 0.43 logMAR preoperatively to 0.05 ± 0.11 logMAR postoperatively. The mean values of a sphere and spherical equivalent showed significant improvements. There were no intraoperative complications and 1.3% of patients reported complications 2 weeks after surgery [20].

Besides, another retrospective observational study with 2102 eyes from 1358 patients aged 45 to 75 years analyzed the visual and refractive outcomes of new aspherical hydrophobic acrylic monofocal IOLs. This study included eyes from patients undergoing routine cataract surgery for uncomplicated age-related cataracts with implantation of an Aktis SP IOL (NS-60YG; Nidek Co. Ltd., Japan) and who participated in regular 1-week follow-ups, 1 month, 3 months and 12 months. The mean preoperative best-corrected visual acuity (BCVA) was 0.56 ± 0.26 logMAR. At 1-year follow-up, the mean uncorrected measurement (UCVA) and postoperative BCVA were 0.11 ± 0.09 and 0.02 ± 0.03 logMAR, respectively. At the end of 6 months, about 1487 (93%) eyes had BCVA of 20/20 and better than 20/30 in 100% of eyes. Mild posterior capsule opacification was observed in 56 patients, but none required Nd YAG laser capsulotomy. There was a reduction in ocular spherical aberration and higher-order aberrations (HOAs) during the preoperative period [21].

Further, one study analyzed histopathologically in 190 IOL samples the transition of lens epithelial remnant cells (LEC) to myofibroblasts and de novo deposition of the ECM component (i.e., smooth muscle actin (SMA) and fibronectin (FN) expression) and determines the intraocular lens (IOL) and patient factors associated with these changes.

Positive SMA expression decreased with increasing IOL implantation time. The positivity of SMA and FN showed a positive correlation. Hydrophobic and hydrophilic materials showed higher expression of FN and SMA when compared to lenses made of silicone material. The square optical design had 29% higher SMA positivity compared to the optic-edge design. One-piece haptics had higher SMA expression compared to threepiece haptics. A higher risk of SMA and FN expression was observed in patients with a history of smoking, hypertension, and glaucoma. Therefore, the expression of SMA and FN is different according to IOL design and patient factors, thus indicating that changes in LEC depend on lens biocompatibility [22].

Finally, a prospective observational clinical study evaluated the depth of field by analyzing the blur curve by applying different visual acuity criteria in patients undergoing cataract surgery and bilateral trifocal diffractive new IOL implantation. A total of fifty eyes from 25 consecutive patients undergoing Asqelio™ trifocal IOL implantation (AST Products Inc., USA) were included. The spherical equivalent was 0.05 ± 0.23D and the residual cylinder was 0.01 ± 0.23D 3 months after surgery. The absolute depth of field obtained was 3.29 ± 0.91D considering 0.1 LogMAR as the cut-off value, and 4.82 ± 0.69 D when 0.3 logMAR is the cut-off value. The relative depth of field considering a 0.1 logMAR drop in maximum visual acuity was 2.57 ± 0.82 D, and 1.27 ± 0.70 D when a 0.04 logMAR drop was considered. Visual acuities obtained 3 months after surgery were 0.03 ± 0.13, - 0.05 ± 0.06, 0.03 ± 0.08 and 0.04 ± 0.08 logMAR for uncorrected and bestcorrected distance for distance, and best-corrected for intermediate and close distances, respectively. The average response to visual satisfaction queries was 8.24/10 at a distance, 8.04/10 at intermediate, and 7.88/10 at close range. Therefore, patients implanted with this trifocal IOL showed a significant improvement in visual acuity at different distances, providing broad absolute and relative values of depth of field, with good patient satisfaction rates [23].

Conclusion

In conclusion, both PCO value and Nd: YAG capsulotomy rates were higher in the hydrophobic acrylic IOL group than in the long-term use silicone IOL group (more than 6 years) after implantation. This study indicates excellent postoperative visual acuity and refractive results in the eyes following implantation of the EyeCee® One. This is accompanied by a very little risk of intraoperative and postoperative complications. Furthermore, the Aktis SP IOL is a safe, effective, and stable lens that can be inserted through a 2.2 mm incision with satisfactory visual and refractive results, even in the late postoperative period. Therefore, by analyzing the histopathological composition of PCO using LECs, more information can be gained about the characteristics of IOLs that are important for biocompatibility. Finally, patients implanted with trifocal IOLs showed a significant improvement in visual acuity at different distances, providing broad absolute and relative depth of field values, with good patient satisfaction rates.

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Ethics approval

Not applicable.

Informed consent

Not applicable.

Data sharing statement

No additional data are available.

Conflict of interest

The authors declare no conflict of interest.

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